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OFFICE OF GRANTS &
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STATUS REPORT

on

RESEARCH GRANT

NSG -- 294 - 63

to

National Aeronautics and Space Administration

on

Field Ion Microscopy

E. S. Machlin

January 31, 1966

Columbia University

New York, N. Y. 10027

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In the preceding period, the research on interstitials in tungsten had a successful conclusion as follows:

1. The visibility of interstitial atoms on (110) ledges in the (110) - ($\bar{1}\bar{1}2$) - (T12) triangular regions of F.I.M. patterns of tungsten was established for carbon and oxygen.
2. The lattice solid solubility of oxygen in tungsten as a function of temperature was measured. The solubility is between 5 - 45 ppm at 1000°C and exceeds 200 ppm at 2100°C.
3. The lattice solid solubility of carbon is less than 10 ppm at 2000°C.

A paper has been written on oxygen as a solute in tungsten. An abstract of this paper is presented in Appendix 1. This paper will shortly be submitted either to J. App. Phys. or J. Mat. Sci. Another paper covering the work on carbon will be written shortly.

The research on substitutional alloys has also proceeded satisfactorily. A cinematographic study of field evaporation in Pt - 2% Au and Pt - 2% W has been initiated. The feasibility of short range order studies in these alloys has been proven. Further, the only explanation of all the observations on the Pt - 2% W alloy that has weathered the

the test of consistency is based on the oscillating potential model of Friedel for the potential field about a solute atom in a metal matrix. With this research, the problems involved in imaging alloys in the F.I.M. have been better defined. In particular, it is now certain that selective field evaporation of either an alloy component, or the nearest neighbor atoms to solute atom components leads to the development of an unrecognizable random pattern of spots in the F.I.M. pattern from an alloy tip. If studies involving disordered substitutional alloys having more than a few percent of solute are to be made, then some experimental technique will need to be developed either to prevent selective field evaporation or to overcome its effects.

In studies of dilute substitutional alloys in addition to the feasibility of short range order and clustering measurements the possibility of imaging substitutional solute as bright spots has also been demonstrated. It is believed that a systematic study of solute-solvent concentrations in which the solute does not selectively evaporate can yield important information concerning the distribution of electric charge and potential about solute atoms in metallic solvents.

Further, it is believed that information concerning the nature and magnitude of the bonds between solute and solvent atoms can be derived from field evaporation potential data from dilute solid solutions.

In the research on interstitial solutes it was also demonstrated that lattice diffusivity data can be obtained from F.I.M. measurements and that the early stages of precipitation of oxides can be followed in the F.I.M. Further, it has been shown that quantitative measurements can be made of the adsorption of interstitial solute to defects such as dislocations and grain boundaries and that the role of substitutional solutes on the behavior of interstitial solutes can be revealed in the F.I.M.

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